I Claim:

1. A method of enhancing evacuation of a multiple-ply bag of the pillow bag type, the pillow bag including a seam at least partially about a circumference of the bag and including at least two upper plies and at least two lower plies, the plies being of substantially identical dimension and being sealed together at respective edges by the seam, regions between the upper plies being sealed off from respective regions between the lower plies, the pillow bag containing a bulk material and including an exit port through which the bulk material can flow from the bag, the method including the steps of:

connecting a region between two plies of the multiple-ply bag to a source of pressurized air;

emptying the viscous contents of the bag through the exit port; and

allowing pressurized air from the source of pressurized air to inflate the region between the two plies when enough of the contents of the bag has been emptied that a pressure exerted on an inner of the two plies by the pressurized air is greater than a pressure exerted on the inner of the two plies by the contents, the inner of the two plies thereby urging the contents toward the exit port of the bag.

2. The method of claim 1 wherein the method further includes placing the bag in a rigid container before pumping so that an exit port of the bag is aligned with a hole in the rigid container.

3. The method of claim 2 wherein the step of providing includes using a bag that is substantially larger than the rigid container so that excess bag material is present when the bag is filled and is in the rigid container.

4. The method of claim 3 wherein the step of providing further includes arranging the bag so that more excess bag material is disposed away from the bag exit port.

5. The method of claim 2 wherein the bag plumps as the region between the two lower plies fills with air until a portion of the bag is visible above the rigid container and the method further includes using the visible portion of the bag as an indicator that the bag is substantially empty.

6. The method of claim 1 wherein the step of pumping includes connecting the bag to a source of pressurized air, the pressurized air having a desired pressure the value of which depends on a yield strength of a material used to make the plies, a total thickness of the plies, and a smallest diameter of the bag when the bag is expanded.

7. The method of claim 1 wherein the step of providing includes forming an air input conduit and the step of pumping includes:

connecting a first end of the air input conduit to a lower region of the bag so that air traveling through the conduit can enter a region between the two lower plies; and

connecting a second end of the air input conduit to a source of pressurized air.

8. The method of claim 1 wherein the step of allowing is performed when the contents have reached a predetermined level.

9. The method of claim 1 wherein the bag is arranged in the rigid container such that folds of excess material from collapse of the emptying bag are pulled taut as the region plumps, thereby at least significantly delaying blockage of the exit port by bag material.

10. An arrangement enhancing output of viscous contents of a bag including:

an air input port formed on a multiple-ply bag, the multiple-ply bag including a plurality of plies of substantially identical perimetral extent, at least one edge of each ply being joined to at least one respective edge of another ply, the air input port being connectable to a source of pressurized air;

an interply region between two plies of the plurality of plies of the bag with which the air input port is in fluid communication so that the interply region can fill with pressurized air from a source of pressurized air when a source of pressurized air is connected to the air input port;

a drain extending from an interior of the bag to an exterior of the bag allowing contents of the bag to be emptied when present;

a portion of the bag acting as a bottom of the bag; and

an inner of the two plies having a bottom part at least partially overlying the bottom of the bag and being arranged so that an increasing portion of the bottom part of the inner ply can become a wall part of the inner ply substantially non-parallel to a the bottom of the bag to increase a depth of the bulk material remaining in the bag.

11. The arrangement of claim 10 wherein the air input port is attached to a first end of an air input conduit and a second end of the air input conduit can be connected to the source of pressurized air.

12. The arrangement of claim 10 wherein the plies include upper plies and lower plies, the upper plies and the lower plies being joined at respective edges to form a seam along at least a portion of a circumference of the bag, the bag thus formed being a pillow bag.

13. The arrangement of claim 10 wherein the source of pressurized air provides air at a pressure less than a desired pressure determined according to the formula

$$p_{desired} \propto \frac{\tau\ t}{D},$$

where τ is a yield strength of a material used to make the plies of the bag, t is a total thickness of the plies, and D is a smallest diameter of the bag when it is expanded.

14. The arrangement of claim 10 wherein the bag is formed so that the bonded edges of the plies lie in a vertical plane when the bag is in use, opposite side edges of the plies being bonded from top edges to bottom edges, and the bag further includes:

a diagonal seam extending from a point along each side edge to a respective point along the top edge;

an unbonded portion of the top edge between the points at which the diagonal seams meet the top edge;

the diagonal seams defining edges of an integral filling conduit of the bag and the unbonded portion of the top edge being a mouth of the integral filling conduit.

15. The arrangement of claim 10 wherein the bag is a fitted bag cut from a length of a gussetted web of multiple-ply bag material and sealed on its ends, the sealed ends partly defining the interply regions.

16. A method of using the bag of claim 10 including the steps of:

connecting a first end of an air input conduit to the air input port of the bag after the bag has been filled with bulk material;

connecting a second end of the air input port to the source of pressurized air so that pressurized air can travel through the air input conduit to the interply region; and

allowing pressurized air to enter into fluid communication with the interply region via the air input conduit and the air input port so that a bottom portion of the inner ply can urge the bulk material toward an exit port of the bag.

17. The method of claim 16 wherein the bag is arranged in a rigid container and the exit port of the bag is substantially peripherally disposed in a bottom of the rigid container and the predetermined level is a level at which the bottom portion of the inner ply can assume a slope toward the exit port.

18. The method of claim 16 wherein the bag is disposed in a rigid container and the exit port of the bag is disposed in a wall of a rigid container adjacent a bottom of the rigid container and the predetermined level is a level at which the bottom portion of the inner ply can assume slope toward the exit port.

19. The method of claim 16 wherein the step of connecting the second end is performed during a setup of the bag in the rigid container.

20. The method of claim 16 wherein the step of connecting the second end is performed when the bulk material reaches a level at which pressurized air can inflate the interply region and cause the inner ply to urge the bulk material toward the exit port.

21. The method of claim 16 wherein the step of allowing is performed when a pressure exerted on the inner ply by the pressurized air is greater than a pressure exerted on the inner ply by the bulk material.

22. A method of enhancing evacuation of a multiple-ply, bulk material-filled bag including a plurality of plies substantially identical to each other in dimension, at least one edge of each ply being joined to a respective edge of at least one other ply, the method including the steps of:

connecting a region between two plies of the bag to a source of pressurized air, one of the two plies being an inner ply and another of the two plies being an outer ply; and

inflating the region between the two plies with pressurized air from the source of pressurized air, the region extending under the bulk material, the pressurized air causing the inner ply of the two plies to urge the bulk material toward an exit port of the bag.

23. The method of claim 22 wherein the step of inflating occurs automatically when a pressure exerted on the inner ply by the pressurized air is greater than a pressure exerted on the inner ply by the bulk material.

24. The method of claim 22 wherein the bag is a pillow bag comprising at least two top plies and at least two bottom plies, the top and bottom plies being joined at edges of the plies, and the region is between two of the bottom plies.

25. The method of claim 22 wherein the step of connecting includes connecting an air input conduit to a source of pressurized air, the conduit being attached to the bag so that the pressurized air can penetrate to the region between the two plies.

26. The method of claim 22 wherein the bag is a pillow bag with an equator at which edges of at least two upper plies of the pillow bag are joined to respective edges of at least two lower plies and the region is between two of the at least two lower plies.

27. The method of claim 22 wherein the step of inflating induces a slope in the inner ply so that a portion of the inner ply near the exit port is lower than a portion of the inner ply distant from the exit port.

28. A method of using the arrangement of claim 10 including the steps of:
filling the bag with viscous contents;
connecting the air input port to a source of pressurized air; and
opening the drain to allow the viscous contents to exit the bag, a portion of the inner of the two plies farthest from the drain port and highest relative to the bottom of the bag plumping in response to pressurized air from the source of pressurized air, the plumping portion of the inner ply thereby pulling the bottom part of the inner ply and causing it to increase its slope so that the increasing portion of the bottom part of the inner ply becomes the wall part.

29. A method of enhancing drainage of viscous contents of a multiple-ply bag, the bag including at least two plies all of substantially identical dimension, the method including the steps of:

pulling an inner ply of two plies of the bag;

changing part of the inner ply from being part of the bottom of the bag to being a movable wall a portion of which is substantially perpendicular to the bottom of the bag;

moving the movable wall toward a drainage port of the bag; and

urging viscous contents of the bag toward the drainage port.

30. The method of claim 29 further including providing an interply region defined by the two plies of the bag and connecting the interply region to a source of pressurized air before pulling, changing, moving, and urging.

31. The method of claim 30 further including inflating the interply chamber by exposing the interply region to pressurized air from the source of pressurized air and opening an exit port of the bag so that, when a pressure balance on the inner ply created by the contents and the pressurized air allows, air enters the interply region.

32. The method of claim 31 wherein tension in the plies defining the interply region increases as the interply region fills with air, an upper portion of the interply region filling first and pulling up on the inner ply, thereby achieving the steps of pulling, changing, moving, and urging.

33. A method of making the arrangement of claim 10 including the steps of:

providing at least two layers of material;

cutting the layers of material to a first size and to a shape having at least four sides;

folding the layers of material in half to form a fold delineating the layers into at least four plies with at least four sides each, the plies including at least two upper plies and at least two lower plies, the region being located between two of the lower plies;

bonding the plies to one another along respective sides;

forming a fill port through the upper plies so that viscous contents can be introduced into an interior of the bag; and

forming the air input port so that air can be introduced into the interply region, the interply region lying between the at least one inner ply and the at least one remaining lower ply.

34. The method of claim 33 wherein the step of bonding includes bonding respective non-fold sides of the plies to each other and the method of making further includes bonding at least the upper plies to one another to form a seam substantially parallel to the fold, the seam and the bonded non-fold sides thereby sealing the interply region.

35. The method of claim 34 wherein the seam includes upper and lower plies and lies substantially along the fold.

36. The method of claim 33 wherein the step of forming the air input port includes forming the air input port through all but at least one inner ply of the lower plies.

37. The method of claim 33 wherein the step of forming the air input port includes inserting the air input port between two plies of the bag at a location that will become seam so that the air input port is in fluid communication with the interply region and with an exterior of the bag.

38. The method of claim 37 wherein the air input port is a multiple-ply tube with interply bonds at ends of the air input port.

39. A system for evacuating semi-flowable bulk material from a multi-ply bag arranged within a shipping container, the system comprising:

an air input passageway extending to an interply region of the bag that extends under liquid contained within bottom plies of the bag supported on a bottom of the container;

the interply region of the bag being configured to contain pressurized air accumulating initially in regions remote from a drain means for the bag and to exclude the pressurized air from substantial upper regions of the bag; and

the bag being configured and located within the container so that pressurized air within the interply region counteracts liquid pressure within the bag to raise a ply of the bag against the bulk material in regions remote from the drain means, thereby urging bulk material toward the drain means and increasing bulk material depth so that folds of material collecting from bag collapse ride on the surface of the bulk material, the surface of the bulk material being maintained at a level above the drain means by the raised ply of the bag in the interply region, thereby preventing blockage of the drain means by the folds of material.

40. The system of claim 39 further including an integral filling conduit of the bag defined by:

side seams of the bag including side edges of the plies bonded to each other;

diagonal seams extending from the side seams to top edges of the plies and defining side edges of the integral filling conduit, the top edges including top edges of back plies and top edges of front plies;

portions of the back ply top edges that are bonded to each other;

portions of the front ply top edges that are bonded to each other; and

a mouth of the integral filling conduit providing access to an interior of the bag between the bonded portions of the back and front ply top edges, the mouth extending between points at which the diagonal seams meet the top edges.

41. The system of claim 39 wherein the interply region extends above a top of the container when the bag is nearly empty, thereby acting as a bag empty indicator.

42. The system of claim 39 wherein the plies defining the interply region are held together at junctures that guide the manner in which air accumulates at locations in the interply region remote from the drain means.

43. The system of claim 42 wherein said junctures are mechanically created by physically pressing the plies defining the interply region together.

44. The system of claim 43 wherein shaped elements are pressed downward against the plies defining the interply region to create said junctures.

45. The system of claim 44 wherein said shaped elements are attached to the drain means.

46. The system of claim 42 wherein said junctures are created using adhesives to join the two plies defining the interply region together.

47. The system of claim 42 wherein said junctures are created using heat sealing to join the two plies defining the interply region together.

48. A combination of a shipping container and a multi-ply bag arranged within the container for holding a semi-fluid material within the multi-plies of the bag for shipment with the container, the combination comprising:

an air inlet arranged in communication with an interply region of the bag extending below an equator of the bag and underneath the material contained within the bag;

seams of the bag being configured to contain within the interply region low pressure air pumped into the interply region and to substantially exclude the low pressure air from a top region of the bag; and

the interply region being arranged to be balloonable in regions remote from a drain means for the bag so that air pressure ballooning the interply region of the bag counteracts material pressure applied in a bottom region of the bag to displace the material toward the drain means.

49. The combination of claim 48 wherein the bag is arranged within the container so that the interply region has more ballooning capability remote from the drain means than adjacent the drain means.

50. The combination of claim 48 wherein the container has an open top when the material is being evacuated, and the ballooning bag extends above the container top to provide a visual indication that the bag is nearly empty.

51. The combination of claim 48 wherein the ballooning of the bag commences when a material level within the bag is low enough so that low pressure air within the interply region can displace the material toward the drain means.

52. The combination of claim 48 wherein the plies defining the interply region are held together at junctures that guide the manner in which air accumulates at locations in the interply region remote from the drain means.

53. The combination of claim 52 wherein said junctures are mechanically created by physically pressing the plies defining the interply region together.

54. The combination of claim 53 wherein shaped elements are pressed downward against the plies defining the interply region to create said junctures.

55. The combination of claim 54 wherein said shaped elements are attached to the drain means.

56. The combination of claim 52 wherein said junctures are created using adhesives to join the two plies defining the interply region together.

57. The combination of claim 52 wherein said junctures are created using heat sealing to join the two plies defining the interply region together.

58. In a bulk material shipping container lined with a bag having a drain for withdrawing semi-fluid contents from the bag, a method of keeping the drain flooded with contents being withdrawn, for more completely emptying the bag, the method comprising:

applying low pressure air to an interply region of the bag extending below an equator seam of the bag and below the contents within the bag; and

prearranging the bag within the container to provide ballooning room opposite the drain for the interply region so that as a contents level within the bag lowers, air pressure balloons the interply region of the bag opposite the drain and displaces the contents toward the drain and keeps the drain flooded with the contents until the bag is nearly empty.

59. The method of claim 58 further including regulating the low pressure air to a desired pressure the value of which depends of a yield strength of a material used to make the plies, a total thickness of the plies, and a smallest diameter of the bag when the bag is expanded.

60. The method of claim 58 further including using the bulk material displaced by the interply region to keep bag material from clogging the drain during withdrawal of the bulk material.

61. The method of claim 58 wherein the interply region is seamed to exclude the interply region substantially from upper regions of the bag above an equator of the bag.

62. The method of claim 22 wherein:

the plies have top, bottom, and side edges;

all plies are bonded along each side edge from top to bottom;

all plies are bonded along non-intersecting diagonal seams extending from a point along respective side edges to respective points along the top edge, the diagonal seams defining edges of an integral filling conduit of the bag; and

a mouth of the integral filling conduit along a portion of the top edge extending between the points at which the diagonal seams meet the top edge, the mouth including back layers of material bonded to each other and front layers of material bonded to each other.

63. The method of claim 34 wherein the bag orientation is changed so that the upper plies are back plies and the lower plies are front plies, and the step of forming the fill port includes the steps of:

bonding the plies to each other along diagonal seams each terminating at one end in a respective one of two opposite bonded non-fold sides at a point between the seam substantially parallel to the fold and a non-fold side opposite the fold, the diagonal seams each terminating at another end along the non-fold side opposite the fold, the diagonal seams thereby defining edges of an integral fill conduit of the bag;

removing flaps of material extending from the diagonal seams to respective corners of the plies;

bonding the back plies to each other along at least a portion of the non-fold side opposite the fold; and

bonding the front plies to each other along at least a portion of the non-fold side opposite the fold;

the bonded back plies and bonded front plies defining a mouth of the integral fill conduit providing access to an interior of the bag, the mouth thereby being the fill port of the bag.

64. The combination of claim 48 wherein the seams of the bag include side seams along opposite edges of the bag and diagonal seams extending from the side seams to a top of the bag to define an integral conduit of the bag, a mouth of the integral conduit extending between points at which the diagonal seams intersect the top of the bag.

65. A container bag having at least two lower plies, which container bag is drained via a top discharge means, comprising:

an air-tight interply region formed between the two lower plies;

an air input passageway extending to the interply region for pumping air into the interply region; and

junctures between the two lower plies within the interply region guiding the manner in which air entering the interply region accumulates.

66. A container bag as described in claim 65 wherein said junctures cause air entering the interply region via the air input passageway to accumulate first at locations remote from a drain means.

67. A container bag as described in claim 65 wherein said junctures are mechanically created by physically pressing the plies defining the interply region together.

68. A container bag as described in claim 67 wherein shaped elements are pressed downward against the plies defining the interply region to create said junctures.

69. A container bag as described in claim 68 wherein said shaped elements are attached to the drain means.

70. A container bag as described in claim 65 wherein said junctures are created using adhesives to join the two plies defining the interply region together.

71. A container bag as described in claim 65 wherein said junctures are created using heat sealing to join the two plies defining the interply region together.